

Pediculosis capitis in Abidjan, Côte d'Ivoire: Epidemiological profile and associated risk factors

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ABSTRACT

Pediculosis capitis (PC) is a parasitic infestation, common in children's communities caused by *Pediculus humanus capitis*. Various factors including infestation-related stigma, treatment cost and health risks make this infestation deserves special attention. This study aims to determine epidemiological profile of pediculosis capitis twenty years after the last study in Abidjan, Côte d'Ivoire.

An epidemiological cross-sectional survey was carried out from April to June 2018 across 40 public primary schools in the ten districts of Abidjan. Data from schoolchildren and parents and/or guardians were collected using a pretested questionnaire after agreement and signature of the informed consent form. Head lice were identified visually with a magnifying glass, and then collected using fine combs and hairbrushes. The positive diagnosis was made by the detection of living lice in the hair.

Of the 4, 805 included participants, 28 (0.58%) were hosting living lice in hair. Analysis of associated factors showed that gender related-status was associated with PC. In this case, girls were more affected than boys ($p=0.018$). Plateau, Treichville and Port Bouët municipalities were the most affected ($p=0.018$). The length hair was associated with the occurrence of PC ($p<0.001$). Schoolchildren from families with low monthly income was most infected by PC ($p=0.023$). Some parameters such as promiscuity and collective use of washing facilities and bedding, were not found to be associated to head lice infestation.

This study shows a drastic decrease of PC prevalence in Abidjan corresponding to 97%. This could be due to the improvement in the quality of life and education of the population of Abidjan. The establishment of hygiene committees and the teaching of basic hygiene practices from the first school years have contributed to these achievements. Maintaining these measures will contribute to the sustainable elimination of CP among children in Abidjan.

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1. Introduction

Sucking lice (Anoplura) are hematophagous wingless insects that can infest birds and mammals (Barker, 1994). Two species infest humans, Two louse species are known to parasitize humans, *Pediculus humanus* and *Pthirus pubis* (Amanzougaghene et al., 2020; Reed et al., 2007). Pubic louse or *Pthirus pubis* is typically acquired through sexual contact, although fomite-borne transmission is possible (Sonthalia et al., 2019). The specie *Pediculus humanus* comprises two ecotypes, notably body lice (*P. h. humanus*) and head lice (*P. h. capitis*). These two ecotypes have almost the same morphology but differ in their ecology and have distinct nutritional patterns (Veracx and Raoult, 2012).

Pediculosis capitis (PC) is widespread throughout the world (Falagas et al., 2008) and remains a common parasitic infestation in children's communities (Salehi et al., 2014). The body louse, *Pediculus humanus humanus*, is well known as an agent responsible involved in the transmission of pathogenic bacteria such as *Rickettsia prowazekii*, *Bartonella quintana* and *Borrelia recurrentis* (Louni et al., 2018; Raoult and Roux, 1999). Recently, pathogenic bacteria have been detected in head lice, *Pediculus humanus capitis* but the role of head lice in the transmission of pathogenic bacteria is not yet defined (Amanzougaghene et al., 2017; Louni et al., 2018). Moreover, several factors make PC a public health problem due to the ease of head lice transmission capacity, stigmatization caused by infestation, treatment cost, and health risks (Kartashova et al., 2019; Lopatina, 2015; Singhasivanon et al., 2019).

The main transmission route for head lice is therefore close head-to-head contact and occurs mostly in children during play. It spreads during contact with an infested person or by sharing clothing, hairbrushes, hats, towels or other personal items of a person already (Meister and Ochsendorf, 2016). The diagnosis of head lice infestation is usually based on the evidence of sighting of lice, detection of eggs attached to hair shafts, itching and inflammation of the scalp and neck. Active infestation is therefore best identified using the "wet combing" technique using a nit detection comb (Feldmeier, 2010; Jahnke et al., 2009). The treatment of head lice involves many strategies including crushing lice after manual or comb removal (Meinking et al., 2002) and chemical products (Sangaré et al., 2016). Several pediculicides have been used against lice. The commonly used are organochlorines (DDT, lindane), organophosphates (malathion), carbamates (carbaryl), pyrethrins (pyrethrum), and pyrethroids (permethrin phenothrin, and bioallethrin). However, pediculicidal and ovicidal efficacy vary by product components (Sangaré et al., 2016). Ivermectin, a macrocyclic lactone, appears to provide encouraging results in the treatment of head lice (Pariser et al., 2013) despite a potential resistance to this molecule being demonstrated in laboratory conditions (Diatta et al., 2016; Yoon et al., 2011).

PC is one of the epidermal parasitic skin diseases, that could be classified as Neglected Tropical Diseases and appears as a minor public health problem for health departments due to the priority given to other infectious diseases (Feldmeier and Heukelbach, 2009). However, in many countries, the prevalence is high, varying from 20% to 65% and majority of parents and guardians in resource poor countries would arguably prefer feasible options to assist them to manage pediculosis (Dagne et al., 2019; Coscione et al., 2018; Ghofleh Maramazi et al., 2019; Rukke et al., 2014; Rassami and Soonwera, 2012; Rukke et al., 2011).

In Côte d'Ivoire, data about pediculosis due to head lice are sparse. The last study conducted in 1997 in primary schools among 409 students has shown a prevalence of adult lice of 18.51% (Ignace et al., 1999). A study carried out by the National Institute of Statistics, has shown that 46.3% of Ivorian population lives below the poverty line (Institut National de la Statistique, 2015). For two decades, Côte d'Ivoire experienced successive socio-political crises which increased social inequalities, population growth in Abidjan and population impoverishment, and there is a lack of information about the prevalence of head lice infestation. These changes likely impact the occurrence of PC. This study aims to determine epidemiological profile of pediculosis capitis twenty years after the last study in Abidjan.

2. Materials and methods

2.1. Study site and sampling design

This cross-sectional study was carried out across 40 public primary schools in the ten municipalities of Abidjan town from April to June 2018 (Fig. 1). The study population included children from four schools randomly selected per municipality. In each municipality, districts were previously divided into 2 groups according to socio-economic level: districts with a low socio-economic level (households having low incoming) and those with a medium socio-economic level. Using the list of public primary schools obtained from the Direction of primary and secondary schools of the Ministry of National Education, we included two schools located in districts of low socio-economic level and two others in districts of average socio-economic level. Schoolchildren's list from selected schools has been used to randomly include 20 schoolchildren per class in the six levels, so the sample size in each school was 120 schoolchildren. Schoolchildren aged at least 4 years old, registered in the school and attended class the day of the survey, were included in the study. After informed consent from parents or legal guardians of schoolchildren, a pretested questionnaire was administered to collect data about sociodemographic and socio-economic factors and background of family infestation, previous infestation and treatment type from each schoolchildren and parent.

The previous study on pediculosis capitis in Abidjan (Ignace et al., 1999), included 2209 children aged between 4 and 15 years in 1997. Diagnostic methods and case definition are the same as in our study.

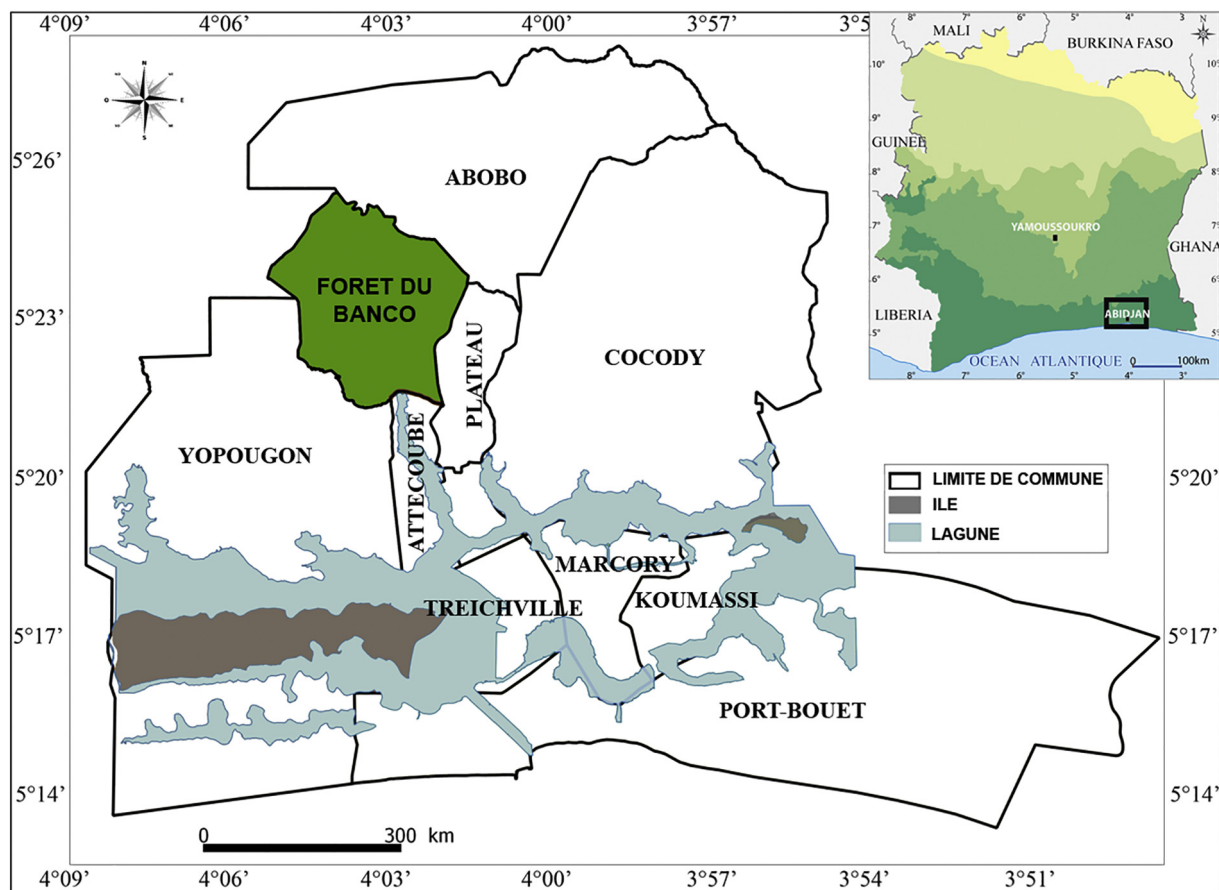


Fig. 1. Map showing municipalities investigated for head lice infestation in Abidjan (Côte d'Ivoire)

2.2. Diagnosis of infestation

Visual inspection was employed for the diagnosis of infestation. Lice were visually identified using a magnifying glass employing hair combs and hairbrushes. Adult parasites or nymphs were looked for on the scalp and also on sheet paper after combing the dry hair. Then, a positive diagnosis was made by the detection of living lice (adult or nymph) (Feldmeier, 2010).

2.3. Data analysis

Statistical analyses were performed with STATA version 15.0 (Stata Corporation; College Station, TX, USA). Univariate analysis (χ^2 and Fisher's exact test, as appropriate) was used for comparison between groups. Children were stratified into four age groups (4–7, 8–10, 11–13 and 14–16 years). Pediculosis infestations were defined as positive by detecting of living adult or nymph lice. Associations and differences with a p-value below 0.05 were considered statistically significant. Odds ratios were computed to test association between risk factors and the occurrence of PC.

3. Results

3.1. Socio-demographic characteristics

A total of 4,805 schoolchildren were examined for head lice in the hair, with 2,274 boys and 2,531 girls (sex-ratio = 0.90). The mean age was 4.8 years (standard deviation (SD) = 2.3 years) with extremes of 4 and 16 years old. Of the 4,805 pupils examined, 28 (prevalence = 0.58%, 95% CI [0.40–0.83]) had PC infestation. Of the 28 infested, 7 (25%) were boys and 21 (75%) were girls. Girls were more infested than boys ($p=0.018$). Municipalities of Plateau, Treichville and Port Bouët were the most affected ($p<0.001$). Fig. 2 shows the prevalence of head lice by municipality. Head itching and hair's length, especially long hair were both statistically associated with the occurrence of pediculosis in our study ($p<0.001$). We also reported that schoolchildren from families with low monthly income was most infected by PC ($p=0.023$). According to promiscuity ($p=0.831$), collective use of washing facilities ($p=0.242$) and children parents' occupation particularly for mother ($p=0.712$) or father ($p=0.825$), no significant

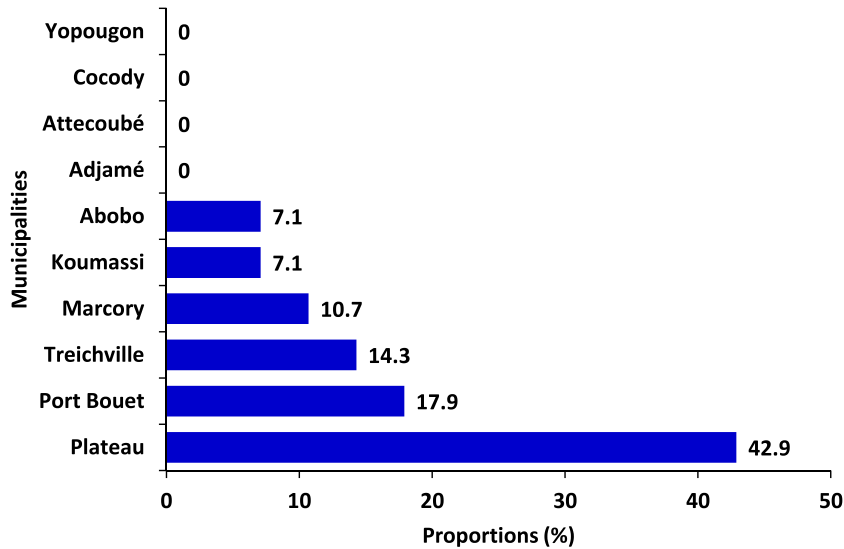


Fig. 2. Prevalence of head lice infestation by municipality in Abidjan

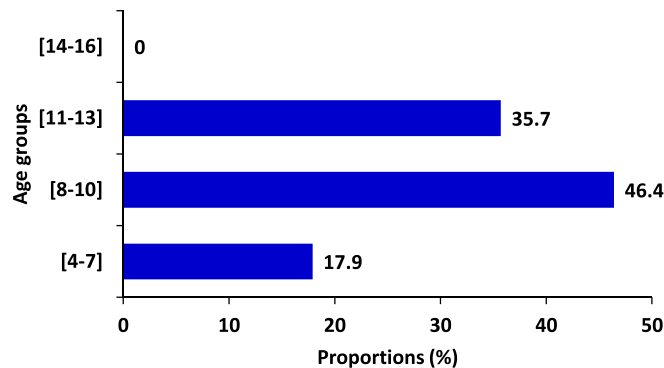


Fig. 3. Prevalence of head lice infestation by age group in Abidjan

association was found the occurrence of head lice infestation. Among examined participants, 0.99% had at least once been infested by PC. However, participants with antecedents of pediculosis were not significantly infected ($p=0.205$). Schoolchildren aged between 8 to 10 are most infested than others but there is not significant difference in head lice infestation between the age groups you stratified ($p=0.279$) (Fig. 3, Table 1). Table 1 shows the sociodemographic and behavioural characteristics of study participants and the occurrence of PC. 65% of Children's parents reported using a variety of products for PC treatment. The most commonly used products were naphthalene (55.4%) and synthetic oils (20.7%) (Fig. 4).

3.2. Factors associated with pediculosis capitis infestation

Table 2 shows the association between PC and associated factors. In our statistical analysis, some variables were found as risk factors for PC, such as sex, family income, hair length and hair itching. Indeed, females were 2.47 times [OR = 2.47, 95% CI (1.15-6.38)] more infested by PC than males. Students having family with low monthly income were 3.57 [AOR = 2.51, 95% CI (1.11-5.72)] times at risk of being infested than those who families have medium income. Moreover, students who had long hair were more infested [OR=2.77, 95% CI (1.32-5.85)] than who had short hair. Clinically, head itching is an important sign in infested children [OR=7.77, 95% CI (2.95-20.46)].

4. Discussion

The current study was designed to update epidemiological data on PC among public primary schoolchildren in Abidjan. The prevalence of PC was very low (0.58%). Girls are more infested than boys and children aged between 8-10 were most susceptible to pediculosis. The low socioeconomic level has been associated with PC.

Table 1
Relationship between sociodemographic and behavioural characteristics of study participants and the occurrence of pediculosis capitis in Abidjan (n=4, 805)

Variables	Frequency	PC+ (%)	p-value
<i>Child school level</i>			0.202
Grade 1	806	3 (0.37)	
Grade 2	797	4 (0.50)	
Grade 3	802	6 (0.75)	
Grade 4	800	1 (0.13)	
Grade 5	799	6 (0.75)	
Grade 6	801	8 (1.0)	
<i>Sex</i>			0.018
Male	2274	7 (0.3)	
Female	2531	21 (0.8)	
<i>Age in years</i>			0.279
[4-7]	1484	5 (0.3)	
[8-10]	2023	13 (0.6)	
[11-13]	1152	10 (0.9)	
[14-16]	146	0 (0)	
<i>District</i>			< 0.001
Abobo	480	2 (0.4)	
Adjamé	481	0 (0)	
Attécoubé	481	0 (0)	
Cocody	481	0 (0)	
Koumassi	480	2 (0.4)	
Marcory	480	3 (0.6)	
Plateau	480	12 (2.5)	
Port Bouet	481	5 (1)	
Treichville	480	4 (0.8)	
Yopougon	481	0 (0)	
<i>Father's occupation</i>			0.825
Government/private worker	1155	5 (0.43)	
Trader	1759	10 (0.57)	
Daily labor	1578	11 (0.70)	
Others	313	2 (0.64)	
<i>Mother's occupation</i>			0.712
Government/private worker	435	3 (0.69)	
Trader	3253	20 (0.62)	
Student	21	0 (0)	
Housewife	1096	5 (0.46)	
<i>Family monthly income</i>			0.023
Low (<180 euros)	2401	20 (0.8)	
Medium (180-360 euros)	2404	8 (0.3)	
<i>Sharing of hair comb</i>			0.242
Yes	1406	11 (0.78)	
No	3399	17 (0.50)	
<i>Sharing of hair brush</i>			0.248
Yes	610	1 (0.16)	
No	4195	27 (0.64)	
<i>Family size per room</i>			0.831
<3	3419	22 (0.64)	
4-6	1270	6 (0.47)	
>6	113	0 (0)	
<i>Hair length</i>			< 0.001
Short (< 5cm)	3655	15 (0.41)	
Long (>5 cm)	1150	13 (1.13)	
<i>Head itching</i>			< 0.001
Yes	1800	23 (1.28)	
No	3005	5 (0.17)	
<i>Antecedent of pediculosis</i>			0.205
Yes	506	5 (0.99)	
No	4299	23 (0.54)	

PC +: Pediculosis capitis positive

The previous study conducted in Abidjan in public primary schools, 20 years ago, reported a prevalence of 18.51% (Ignace et al., 1999), significantly higher than that we reported in this study. This corresponds to a decrease of the head lice infestation of 97%. The low prevalence obtained in the current survey shows that PC is in sharp decline in Abidjan. These results are in line of those reported from some areas of sub-Saharan Africa, particularly Nigeria (Ebomoyi, 1988, 1994; Okoh and Alikor, 2013; Salehi et al., 2014). However, highest prevalences have been reported in Africa (Morsy et al., 2001; Sangaré et al., 2015) and other parts of the world (Khamaiseh, 2018; Lye et al., 2017; Nejati et al., 2018; Shirvani et al., 2013). This variation in

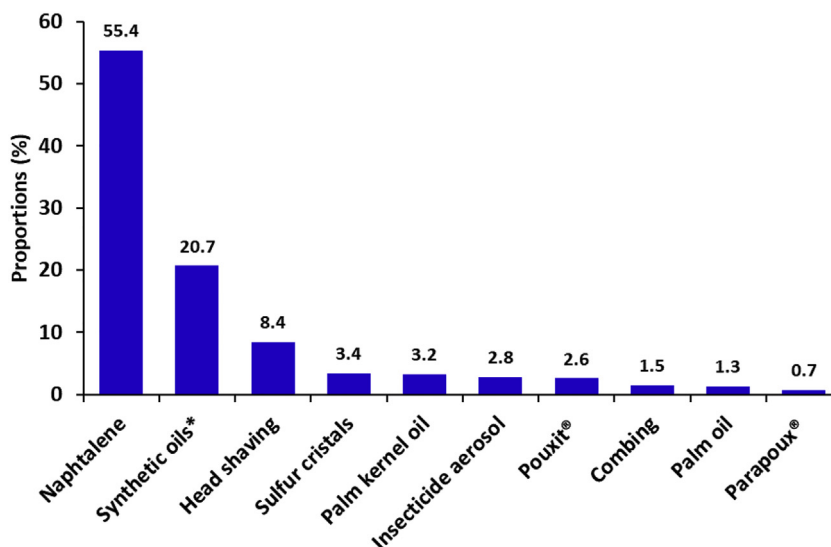


Fig. 4. Products used by schoolchildren's parents for head lice treatment

Table 2

Associated factors of pediculosis capitis among schoolchildren in Abidjan (n = 4, 805)

Variables	Pediculosis		OR (95% IC)
	No	Yes	
Sex			
Male	2267	7	1
Female	2510	21	2.47 (1.15-6.38)*
Family monthly income			
Low (<180 euros)	2381	20	2.51 (1.11-5.72)*
Medium (180-360 euros)	2396	8	1
Family size per room			
<3 persons	3397	22	1.49 (0.60-3.67)
≥ 3 persons	1377	6	1
Sharing of hair comb			
Yes	1395	11	1.57 (0.73-3.36)
No	3382	17	1
Sharing of hair brush			
Yes	609	1	1
No	4168	27	0.25 (0.034-1.87)
Hair length			
Short (< 5cm)	3640	15	1
Long (≥ 5 cm)	1137	13	2.77 (1.32-5.85)**
Head itching			
Yes	1777	23	7.77 (2.95-20.46)**
No	3000	5	1
Antecedent of pediculosis			
Yes	501	5	1.86 (0.70-4.90)
No	4276	23	1

OR : odds ratio, CI confidence interval

Significant at * p ≤ 0.05, ** p ≤ 0.001

infestation rate between localities might be explained by many efforts, such as lice control policy, eradication strategies, number of head-to-head contacts, personal hygiene, promiscuity, socio-economic status (Rassami and Soonwera, 2012; Salehi et al., 2014). The low prevalence of PC could also be explained by the use of ivermectin in Abidjan for several years for mass drug administration against onchocerciasis and lymphatic filariasis, parasitic diseases that are still endemic in Côte d'Ivoire. Municipalities of Cocody and Yopougon are endemic to lymphatic filariasis and onchocerciasis. The population of these localities receive annual mass administration of ivermectin and albendazole since 2016. This corresponds to four rounds of preventive chemotherapy of these medicines to the entire at-risk population. It should be noted that these municipalities have a zero prevalence of PC infestation. Furthermore, ivermectin has shown its effectiveness in the treatment of PC after oral or local administration (Ahmad et al.,

2014; Chosidow et al., 2010; Nofal, 2010). Coscione et al. (2018) demonstrated that ivermectin used for scabies control, had a collateral benefit on head lice infestation, as well.

In the current study, the high prevalence of PC infestation in girls was also observed in many studies (Abd El Raheem et al., 2015; Dagne et al., 2019; Govere et al., 2003; Ignace et al., 1999). Girls usually play in small groups and their activities involve mostly head-to-head contact, which might increase the transmission of *P. humanus capitis*. In accordance with the present results, previous studies have demonstrated that hair length was positively correlated with the occurrence of PC (Gunathilaka et al., 2019; Salehi et al., 2014). A possible explanation for this might be that girls in Abidjan public primary schools usually have longer hair than boys. Long hair is a more appropriate habitat for lice to reproduce, nourish and protect them. This might also be due to the habit of female students to have long hairs that can harbor the parasite and have close relationships with other girls, involving multiple and intimate body contact than boys (Dagne et al., 2019). In contrast, in another study the prevalence of PC infestation was not associated with sex of children (Mumcuoglu et al., 1990). Students having family with low monthly income were the most infested. This confirms the impact of socio-economic conditions on PC infestation in line with previous studies (Karakus et al., 2014; Saddozai and Kakarsulemankhel, 2008).

Pediculosis capitis treatment uses various products and the efficacy is not well known for children health. Pediculicides with demonstrated efficacy on lice (Heukelbach et al., 2008; Munirathinam et al., 2009; Sangaré et al., 2016; Verma and Namdeo, 2015) were used only in a very low proportion. Moreover, pupil's parents mainly used products such as naphthalene mothball and synthetic motor oils. The toxicity of naphthalene in humans is well known (Sudakin et al., 2011) and studies about its genetic toxicity are still being discussed (Bogen et al., 2008). Use of motor oils and other toxic products to control PC is suggested linked to low socio-economic levels of infested people for whom medicines sold in pharmacies are relatively expensive for PC infestation treatment (Heukelbach and Ugbomoiko, 2011).

The current study has some limitations and bias, and hence, the findings should be interpreted with care. Data about sociodemographic, socioeconomic, sanitary conditions, and environmental factors were collected through a pretested questionnaire administered to children and parents/guardians. There might be some kind of reporting bias. Moreover, no information was collected knowledge and attitude from participants about PC infestation.

5. Conclusion

The prevalence of PC in Abidjan has decreased since twenty years. The main associated factors reported in the current study include sex, family income, hair length and hair itching. Hence, educational campaigns targeting children and parents, improvement of life quality and application of hygiene measures in public primary schools strategies by national health authorities will contribute to the reduction of PC in Abidjan.

Declaration of Competing Interest

There is no conflict of interest for this study.

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